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WATER RESOURCES STUDY. RUNNING WATER DRAW WATERSHED, BRAZOS RIVER BASIN, TEXAS AND NEW MEXICO

Public Health Service
Dallas, Texas

August 1964

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WATER RESOURCES STUDY
RUNNING WATER DRAW WATERSHED
BRAZOS RIVER BASIN
TEXAS AND NEW MEXICO

Study of Potential Needs and Value of Water Storage for Municipal, Industrial, and Quality Control Purposes

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Dallas, Texas
AUGUST 1964

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WATER RESOURCES STUDY

RUNNING WATER DRAW WATERSHED

BRAZOS RIVER BASIN

TEXAS AND NEW MEXICO

Prepared for

DEPARTMENT OF THE ARMY

U.S. Army Engineer District

Fort Worth, Texas

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

AUGUST 1964

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I. INTRODUCTION

Authority

In a letter dated April 9, 1963, the U.S. Army Engineer District, Fort Worth, Texas, requested the Public Health Service to make studies and investigations to determine municipal and industrial water requirements, the quality of water, the extent of existing and potential pollution, as well as the need for and the benefits from conservation storage for purposes of municipal and industrial water supply, and water quality control in the Running Water Draw watershed, Brazos River basin, Texas and New Mexico. These studies, including projections to the year 2070, have been made in accordance with (1) a Memorandum of Agreement between the Department of the Army and the Department of Health, Education, and Welfare, dated November 4, 1958, relative to Title III, Public Law 85-500, as amended by Public Law 87-88, and (2) Public Law 84-660, as amended by Public Law 87-88.

Purpose and Scope

The purpose of the study was the determination of water requirements for municipal and industrial, and water quality control purposes to the year 2070 in the Running Water Draw watershed in the southern high plains of Texas and New Mexico. A suggested plan of development of the water resources of the watershed is also included. This plan utilizes water imported from Sanford Reservoir in the Canadian River basin and conservation of the watershed's ground water resources.

Acknowledgments

The cooperation of many persons and agencies is gratefully acknowledged. Special appreciation is expressed to the following:

U.S. Army Engineer District, Fort Worth, Texas
Texas Water Commission, Austin, Texas
New Mexico State Engineer Office, Santa Fe, New Mexico

II. SUMMARY AND CONCLUSIONS

Summary

1. The study area comprises Floyd, Hale, Lamb, Swisher, Castro, and Parmer Counties in Texas, and Curry County in New Mexico, part of each being located within the Running Water Draw watershed.

2. Irrigated agriculture is the mainstay of the area's economy and accounts for the major portion of its water requirements. Large withdrawals of water for agriculture are depleting ground water in the area's principal aquifer.

3. Running Water Draw is an intermittent tributary of the White River in the upper reaches of the Brazos River basin. It drains an area of about 1,700 square miles all of which is considered as noncontributing to the Brazos River.

Conclusions

1. To insure continued growth, careful planning for efficient use and conservation of the area's ground water resource is essential. Realization of the full potential of this resource for municipal, industrial, agricultural, and recreational purposes will be possible only with early development and implementation of a comprehensive ground water management program.

2. The study area's population is expected to reach 242,000 by the year 2020 and 337,500 by the year 2070 from a base of 132,867 in the year 1960. Similar projections for the watershed only are 72,500 and 106,000 in 2020 and 2070, respectively.

3. Projected municipal and industrial water supply needs for the watershed are 17.4 million gallons per day (mgd) in 2020 and 31.6 mgd in 2070.

4. With careful management, the potential water resources of the watershed including imports of 3,800 acre-feet per year from the Canadian River basin are sufficient to satisfy all projected municipal and industrial water requirements until the year 2070.

5. Continuation of the practice of irrigating with treated waste waters will prevent the occurrence of surface water quality problems.

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III. DESCRIPTION OF THE WATERSHED

Running Water Draw is an intermittent tributary of the White River in the upper reaches of the Brazos River basin. It has a shallow and broad channel about 160 miles in length and drains a cresent-shaped area of approximately 1,700 square miles, all of which is considered as noncontributing to the Brazos River. The watershed occupies part of Floyd, Hale, Lamb, Swisher, Castro, and Parmer Counties in Texas, and Curry County in New Mexico. These same counties were selected as the study area, as they are considered to be the economic region affected by the watershed.

The study area has a mean annual rainfall of about 22 inches, an average annual temperature of 60°F. (January, 41°; July 78°), and a growing season of about 220 days. The topography of the area may best be described as being a semiarid plateau region known locally as the "high plains", having a gentle northeast to southwest slope.

The city of Plainview in Hale County is now and is expected to continue to be the principal municipality in the watershed. Other cities in the watershed are Lockney, Floyd County; Olton, Lamb County; and Bovina, Parmer County. A map illustrating the watershed and study area is shown in figure III-1, following page VII-2.

IV. THE ECONOMY

Present

The economy of the Running Water Draw study area is centered around irrigated agriculture. Nearly a third of the labor force was employed by agriculture in 1960, as shown in table IV-1. 1/ Manufacturing activity is closely associated with irrigated agriculture, with food and kindred processing employing more than one-third of the 1960 manufacturing labor force. 1/ Since 1959, two vegetable canning companies and a producer of concrete irrigation pipe have located in Plainview, the largest city in the drainage area. 2/ Over the last four decades, the population of the study area has increased some 230 percent, to 132,867 in 1960. 3/ During the same period, population of the watershed increased 210 percent. (See figures IV-1 and IV-2 for the 40-year trend.)

Future

As discussed in the following chapter, ground water is being mined in this area and could be depleted by the year 2000, if present withdrawal rates continue. However, with good irrigation conservation practices, and shifts in agricultural cropping patterns to crops yielding a higher value of output per unit of water, ground water in the area could last much longer without reductions of agricultural income and industrial growth associated with irrigated agriculture. One crop which accomplishes this, and is becoming increasingly important in the high plains, is commercial vegetable production. Manufacturing growth is expected to center around the nucleus of agriculturally oriented industries which are presently located in the study area. These anticipated shifts in agricultural water use, cropping patterns, and associated shifts in employment, are reflected in labor force projections. (See table IV-1.)

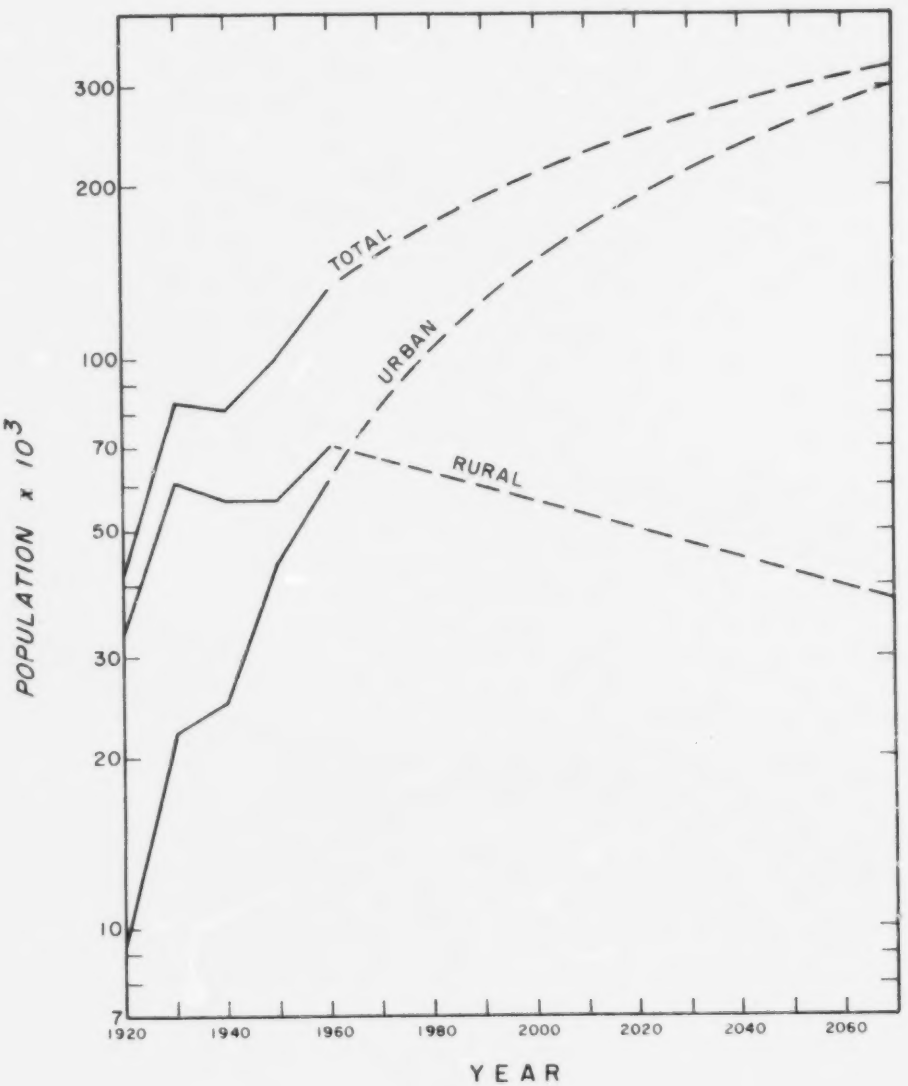
Table IV-1

Present and Projected Study Area
Labor Force Distribution

Item	1960*		2020		2070	
	Number	Per cent	Number	Per cent	Number	Per cent
Agriculture	14,440	31.4	11,185	12.8	9,580	7.8
Mining	158	0.3	235	0.3	300	0.2
Manufacturing	1,865	4.1	10,580	12.2	18,400	15.0
Resource Oriented	1,107	2.4	5,650	6.5	8,750	7.1
Nonresource Oriented	758	1.7	4,930	5.7	9,650	7.9
Basic Total	16,463	35.8	22,000	25.3	28,280	23.0
Services	27,926	60.7	61,700	70.9	89,800	73.0
Unemployed	1,593	3.5	3,300	3.8	4,920	4.0
Total Labor Force	45,982	100.0	87,000	100.0	123,000	100.0

*Source: Bureau of the Census 4/

Based on a resource and employment analysis, the study area population is expected to reach 242,000 by 2020 and 337,000 by 2070. Similarly, the watershed population is expected to reach 72,000 by 2020 and 106,000 by 2070. Population projections for the study area and for the watershed are shown in figures IV-1 and IV-2, respectively.

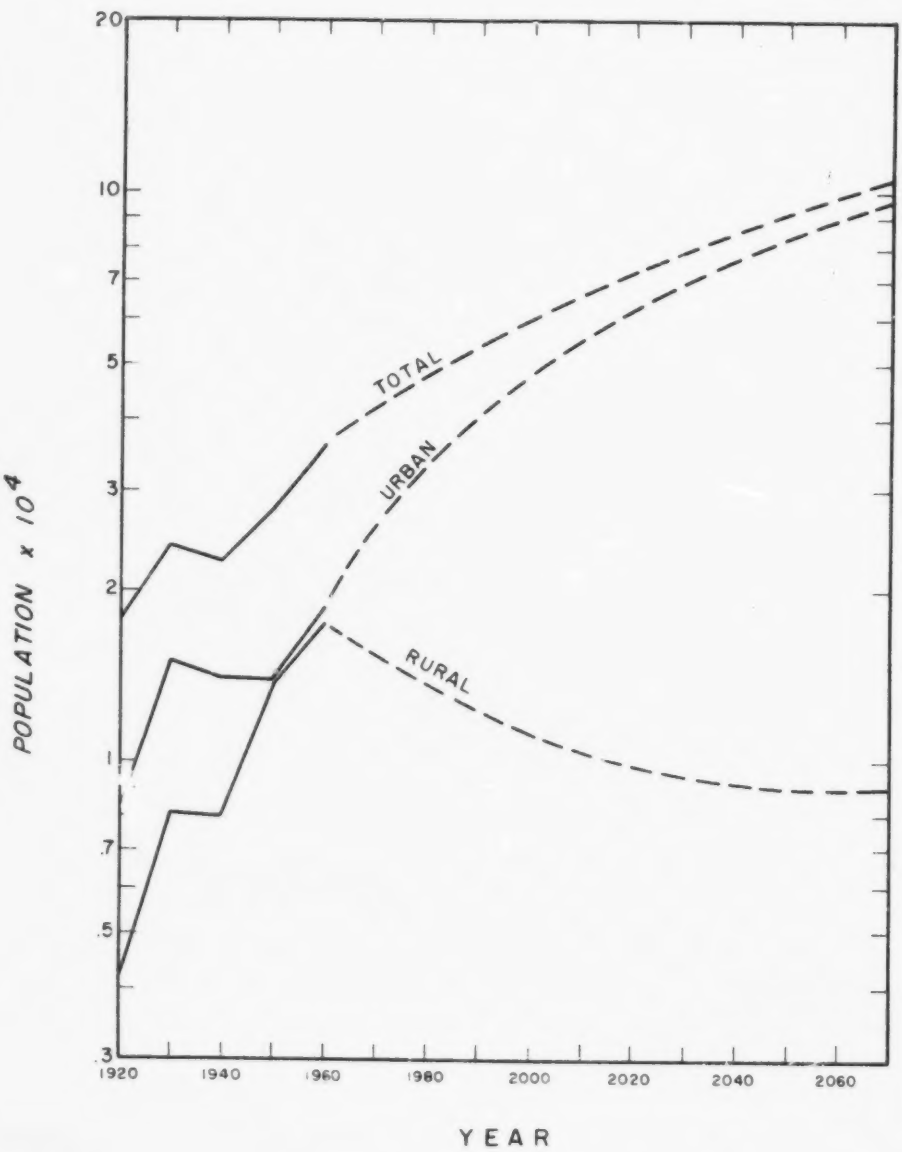


WATER RESOURCES STUDY
RUNNING WATER DRAW WATERSHED
BRAZOS RIVER BASIN - TEXAS & NEW MEX.

POPULATION PROJECTION
STUDY AREA

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE IV-1



WATER RESOURCES STUDY
RUNNING WATER DRAW WATERSHED
BRAZOS RIVER BASIN-TEXAS & NEW MEX.

POPULATION PROJECTION
WATERSHED

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

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FIGURE IV-2

V. WATER REQUIREMENTS

General

The term water requirements encompasses a multiplicity of uses which are dependent on a large number of variables. Although primarily concerned with municipal and industrial water use, this study examines other water uses that affect the supply and demand for water within the watershed. The probable future water requirements of the watershed are based on economic projections, coupled with analyses of unit water requirements. The various water uses are discussed below, and a summary of present and future water use is shown in table V-1 and presented graphically in figure V-1.

Table V-1

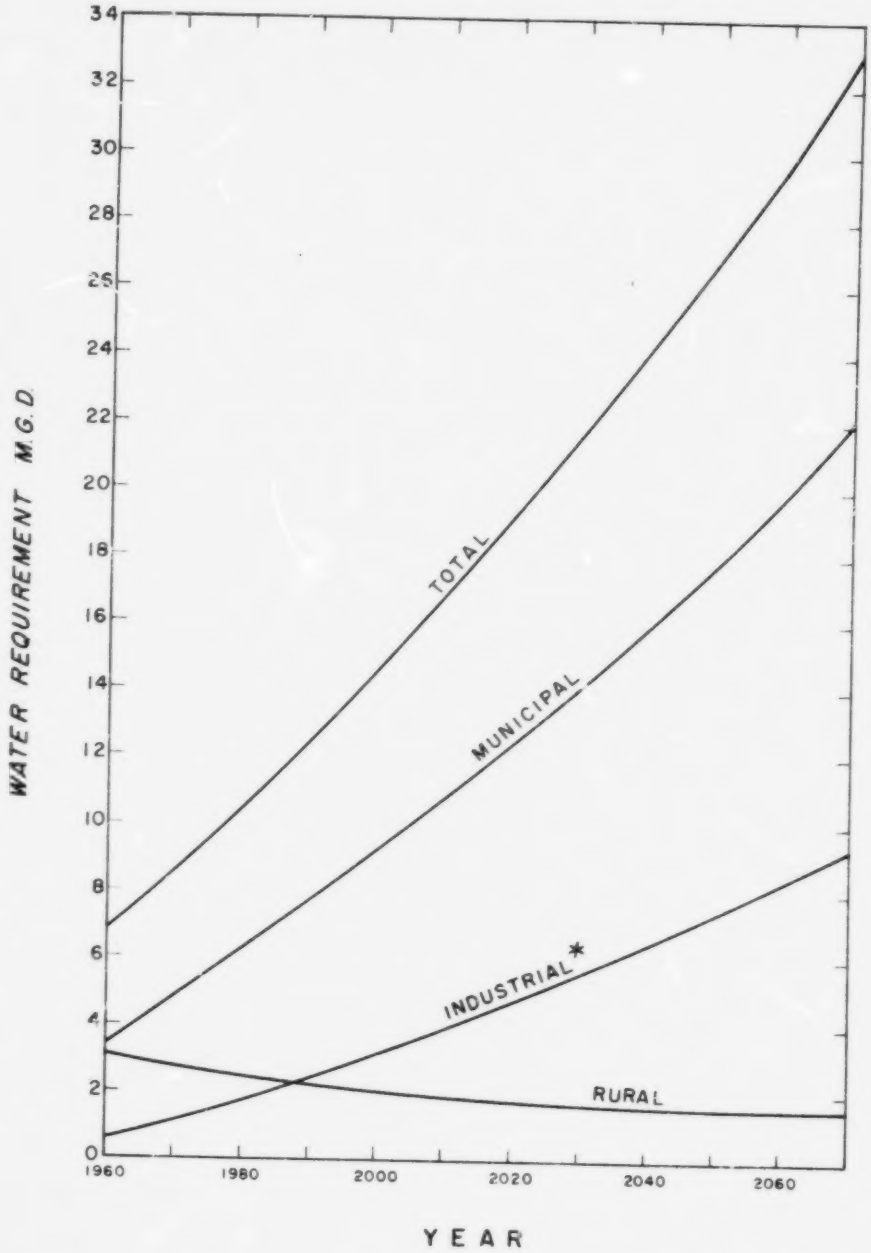
Water Requirements in the Watershed
(mgd)

Year	Municipal	Industrial*	Rural	Water Quality Control	Total Except for Irrigation
1960	3.4	0.6	2.8	0	6.8
1970	4.8	1.1	2.7	0	8.6
1995	8.7	2.8	2.2	0	13.7
2020	12.5	4.9	1.8	0	19.2
2045	16.9	7.1	1.7	0	25.7
2070	22.2	9.4	1.6	0	33.2

* Including thermal power generation.

Municipal Water Use

Municipal water use is defined here as being municipally supplied water for all purposes excluding that supplied to industrial establishments. Included in the resulting per capita quantities are losses in the distribution systems, and treatment plant attenuation. Municipal water needs are calculated by multiplying the estimated per capita use by the population that is expected to be served. The unit municipal water use is expected to increase from 179 gallons per capita day (gpcd) in 1960 [5/] to 200 gpcd in 2020, and 230 gpcd in 2070.



*INCLUDES THERMAL POWER GENERATION

WATER RESOURCES STUDY
RUNNING WATER DRAW WATERSHED
BRAZOS RIVER BASIN-TEXAS & NEW MEX.

WATER REQUIREMENT
WATERSHED

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

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FIGURE V-1

Industrial Water Use

The definition of industrial water used here refers to all water regardless of source used by the manufacturing industries (Standard Industrial Classification categories 13, 14, and 20-39). The total industrial requirements are determined by combining the projected number of employees with the projected unit employee water use for each of the several industrial categories.

Power Generation Water Use

Consumptive use of water for thermal power generation is a part of the industrial requirement that has been determined separately. Information on future water use was gathered from power suppliers in the area and combined with data developed by the Federal Power Commission and the Edison Electric Institute for the Senate Select Committee on National Water Resources. Water needs for this purpose are included in the industrial water column shown in table V-1.

Rural Water Use

For purposes of this study, rural water requirements are assumed to consist of domestic water for that portion of the rural population not served by municipal water systems and water for the maintenance of livestock. The rural per capita use is expected to remain constant at 180 gallons per day (gpd), of which 80 gpcd are for the maintenance of livestock.

Irrigation Water Use

The greatest water use in the study area at present is for irrigation. No projections of irrigation water use were made since it is generally conceded that the area will revert to dryland farming as water levels continue to drop in the Ogallala Formation from which all water in the area is obtained. The 1959 use for this purpose was 528,000 acre-feet per year. 6/

Water Quality Control

No need for water for quality control purposes is anticipated in the watershed, since all waste flows in the area are expected to be used for irrigation after receiving a high degree of treatment.

//

VI. WATER RESOURCES

The watershed is underlain in most places by unconsolidated rocks of Pliocene and younger age, a part of which constitute the Ogallala Formation, the principal fresh water-bearing aquifer in the area. Water from the Ogallala Formation is characteristically hard and in most places has an excessive concentration of fluoride. The water is fairly low in minerals, containing about 400 milligrams per liter (mg/l) of dissolved solids. The chemical analysis shown in table VI-1 gives the range of constituents characteristic of the water from the Ogallala Formation in the watershed.

Table VI-1

Characteristic Analysis of Water from Municipal Wells in the Running Water Draw Watershed February 1945 through March 1959

Item	Concentration (mg/l)		
	Max.	Min.	Avg.
Iron, (Fe)	0.12	0.00	0.05
Calcium, (Ca)	59	44	49
Magnesium, (Mg)	45	23	34
Sodium, (Na)	69	12	36
Sulfate, (SO_4)	38	18	30
Chloride, (Cl)	47	18	28
Fluoride, (F)	3.6	1.8	2.9
Nitrate, (NO_3)	6.8	1.2	3.5
Bicarbonate, (HCO_3)	376	289	331
Potassium, (K)	13.0	7.9	9.8
Silica, (SiO_2)	60	33	50
Total Hardness (as $CaCO_3$)	300	236	265
Dissolved Solids (Residue at 105°C.)	494	333	409
pH (in pH units)	8.0	7.4	7.6

Source: Texas State Department of Health 7/, and Texas Water Commission 8/

This water has been used for domestic, industrial, and irrigation purposes to the present. Its use for irrigation has produced satisfactory results, while its hardness, fluoride, and silica concentrations make it somewhat objectionable for domestic and many industrial uses.

VII. SUGGESTED WATER SUPPLY PLAN

In the Running Water Draw watershed, 528,000 acre-feet of water were pumped from the Ogallala Formation, the principal aquifer, in 1959. 6/ The Texas Water Commission estimates that approximately 24,180,000 acre-feet of the ground water remaining in storage in the Running Water Draw watershed portion of the Ogallala Formation is available to wells. 6/ The amount of water which can feasibly be withdrawn from the aquifer, however, will be somewhat less than this total. If the present ground water withdrawal rates in the watershed prevail, it is estimated that the Ogallala Formation will become depleted by about the year 2000.

The city of Plainview is now, and can be expected to be in the future, the largest user of municipal and industrial water in the watershed. A present agreement provides for a surface supply of 3,800 acre-feet per annum for Plainview from Sanford Reservoir on the Canadian River. Construction of a reservoir in the watershed to supply municipal and industrial needs is not feasible and surrounding watersheds are deficient, ruling out further importation. Therefore, it appears that ground water will have to supply the municipal and industrial needs of the watershed if the projected growth is to occur.

Table V-1 shows that the municipal and industrial, and rural water requirements for the terminal year of the study will be 33.2 mgd, or 37,200 acre-feet per year. Deducting the firmly committed supply from Sanford Reservoir leaves a deficit of 33,400 acre-feet per year. It was calculated that the storage required to satisfy municipal and industrial and rural water needs throughout the projection period (1960 - 2070) is 2,233,000 acre-feet.

It is generally conceded that irrigation in the watershed will become uneconomical and will stop as ground water levels are lowered. Since irrigation withdrawal rates are far in excess of foreseeable municipal and industrial needs, it may be possible to satisfy these latter requirements through curtailment of irrigation. Assuming that 85 percent or 20,600,000 acre-feet of the theoretically available stored ground water could be feasibly withdrawn, and subtracting the 2,233,000 acre-feet needed for municipal and industrial, and rural uses, would leave a total of 18,367,000 acre-feet available for irrigation. At the present withdrawal rate then it would be possible to continue irrigation to about the year 1995 and still have enough storage remaining to satisfy all other requirements through the year 2070.

To implement any plan of this nature would, however, require considerable field study, as well as new State legislation to provide for thorough management of the ground water resources.

The foregoing plan is included only as a suggestion and no estimates of costs for well fields and collection systems are included. The only water resource in this area is its store of ground water and further importation of water from surrounding basins, although remotely possible, seems infeasible at this time. Therefore, some form of ground water conservation plan will have to be put into effect, so that the area can continue to prosper and grow.

Presently, the return flow of all municipalities in the area, with the exception of Plainview, is discharged to either playa lakes or on land for irrigation purposes. Plainview, however, discharges directly to the White River. With the anticipated depletion of ground water in the area, all of the return flows produced can be expected to be utilized for irrigation; therefore, no surface water quality problem is anticipated in the watershed.

Using the best data presently available, it is concluded that ground water from the Ogallala Formation, with treatment to correct its quality, can satisfy future municipal and industrial water requirements of the area if properly and effectively managed. However, the watershed should be restudied in the event present estimates of water quantity and quality become altered.

STUDY AREA
NEW MEXICO
TEXAS
VICINITY MAP
FLOYD
Floydada
Lockney
WHITE RIV.
SWISHER
Tulia
Plainview
Hale Center
HALE
LIMIT OF STUDY AREA
CASTRO
Dimmitt
Olton
LAMB
Littlefield
RUNNING WATER DRAW
PARMER
Bovina
Farwell
TEXAS
NEW MEXICO
FRICO DRAW
TENMILE DRAW
CURRY
Clovis
WATERSHED BOUNDARY
SCALE IN MILES
0 8 16
WATER RESOURCES STUDY
RUNNING WATER DRAW WATERSHED
BRAZOS RIVER BASIN-TEXAS & NEW MEX.
LOCATION MAP
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII
DALLAS, TEXAS

FIGURE III-1

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